

Temporal Trends in the Areal Extent of Canopy-forming Kelp Beds Along the Strait of Juan de Fuca and Washington's Outer Coast

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Extended Abstract

Kelp beds are important nearshore habitats that support commercial and sport fish, invertebrates, marine mammals and marine birds. Many factors, both natural and anthropogenic, affect the extent and composition of kelp beds. For example, elevated water temperature and intense sea urchin grazing can decimate kelp beds. El Niño events stress kelp by producing severe winter storms and reducing upwelling events which normally replenish the nutrients in the water column. Human influences on kelp beds include sewage and other runoff that decreases water quality by changing the nutrient levels and reducing light in the water column. Kelp plants also can be physically damaged by boat propellers and fishing gear. Commercial harvest of kelp is not a significant factor in Washington State due to a law prohibiting this practice.

The DNR Nearshore Habitat Program in Washington State has inventoried canopy-forming kelp beds annually since 1989. This long-term data set will help us to understand how the extent of kelp canopies changes over time. The challenge is to differentiate the natural yearly fluctuation in this dynamic population from changes due to human impacts or due to local or regional environmental conditions.

The kelp canopy monitoring study area includes the mainland shoreline along the Strait of Juan de Fuca and Washington's outer coast, from Port Townsend to the Columbia River. Data has been collected yearly since 1989, with the exception of 1993. We collect 70 mm, color-infrared aerial photography during low tides in late summer, when the kelp canopy is at its maximum extent. The photography scale is 1:2,500. Kelp canopy information is transferred from the photography onto USGS 7.5 minute Topographic Maps that have been enlarged to 1:12,000. The species composition of each bed is classified according to whether it is bull kelp (*Nereocystis leutkana*), giant kelp (*Macrocystis integrifolia*) or mixed. Canopies are then grouped together into beds using Global Lab Image Software, an automated routine groups plants within 50 meters, giving each plant a 25-meter radius of association. Grouping canopies into beds allows for comparison to other mapping systems, which generally outline beds as a whole instead of individual canopies.

Preliminary analysis of the 1989-1999 data set shows that the areal extent of kelp varied highly from year to year. Changes in kelp extent were significantly different in 7 out of the 9 yearly comparisons (95% confidence interval). The extent of kelp was lowest in 1997 (722 hectares) and greatest in 1999 (1787 hectares). In spite of high yearly variability, no long-term trend is apparent between 1989 and 1999, suggesting that the population may be stable.

While the population seems stable over the study area as a whole, some local losses of kelp are evident. For example, the kelp bed north of Protection Island near Port Townsend gradually dwindled from 181 acres in 1989 and disappeared in 1997. Nearby upland impacts are presumed to be minimal because the island is a National Wildlife Refuge.

The species composition of the canopy-forming kelp beds varied greatly from year to year, reflecting the different responses of bull kelp and giant kelp to environmental conditions. Giant kelp canopies covered a

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larger area in 5 of the 9 years monitored. Giant kelp consistently had higher density, ranging from 0.34 - 0.40, in comparison to bull kelp which ranged from 0.19 - 0.30. Other differences between species of floating kelp were also evident. Bull kelp populations showed much higher year-to-year variation in total extent.

In 1997, during an El Niño event, the total kelp canopy area decreased by 32%. We are now trying to understand the relationship between the kelp population and this regional climate perturbation. In 1997, losses varied in magnitude between areas and between floating kelp species. Losses were highest in the bull kelp (*Nereocystis luetkeana*) populations along the outer coast, which experienced 75% loss. Over the same area, giant kelp (*Macrocystis integrifolia*) populations decreased by 8%. During the subsequent year, 1998, the overall floating kelp population increased by 87%, and the outer coast bull kelp populations increased by 423%.

Comparison of the long-term kelp canopy data to other environmental information could provide insight into how kelp responds to natural and human impacts. Additionally, it could be used to better understand trends in species that utilize kelp habitats.

References

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